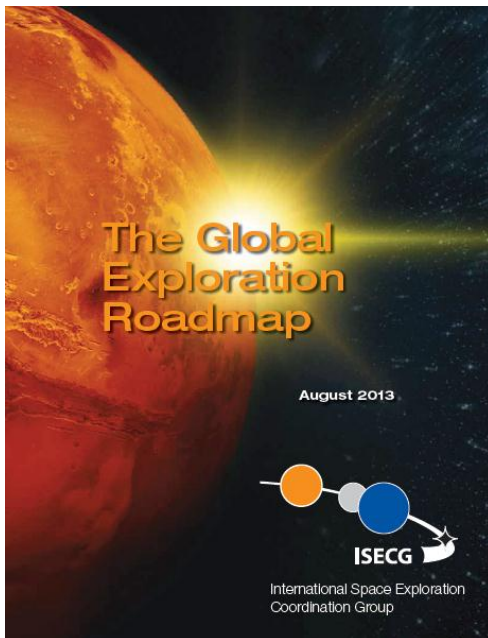




In Space Transportation Technologies Supporting the Global Exploration Roadmap

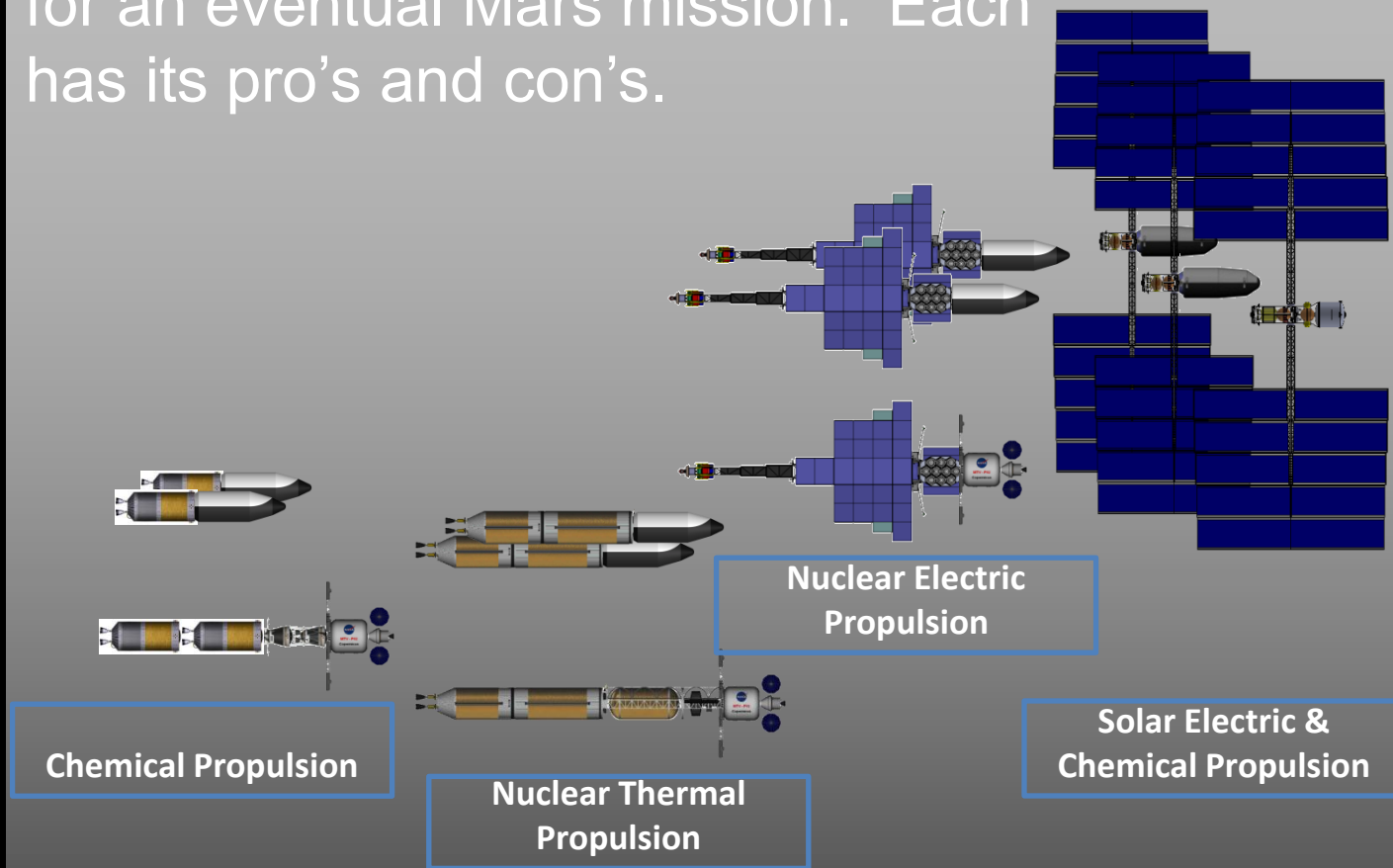


Les Johnson
(NASA George C. Marshall
Space Flight Center)



There are many technical solutions for an eventual Mars mission. Each has its pro's and con's.

Sending People To Mars – It's All About Moving Mass





Human Exploration Preparatory Activities from the GER



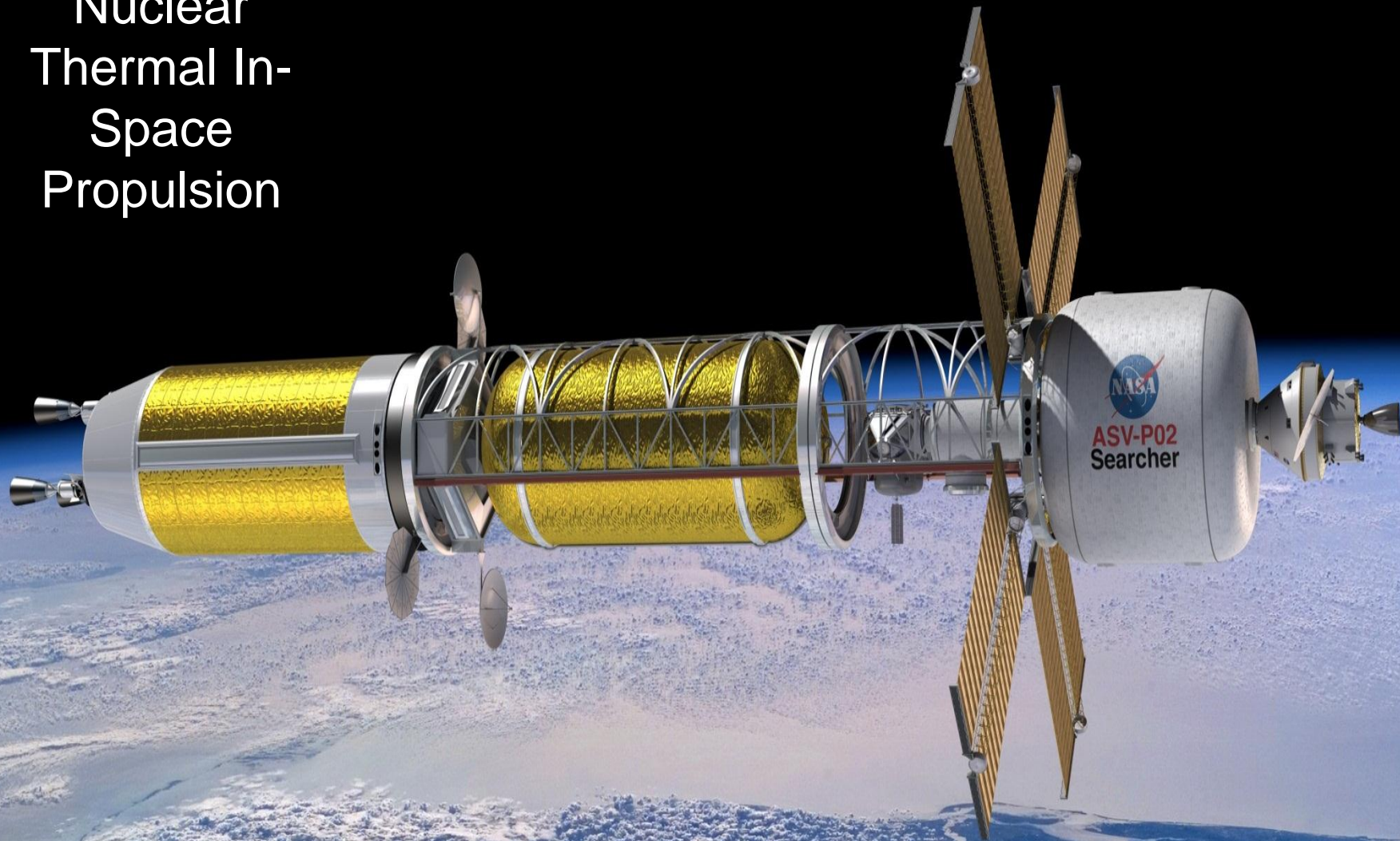
Critical Technology Needs by Technology Area²

In-Space Propulsion Technologies (TA02)	Life Support & Habitation Systems (TA06)
<ul style="list-style-type: none">• Liquid Oxygen/Methane Cryogenic Propulsion System (Mars Lander)• Advanced In-Space Cryogenic Propellant Storage & Liquid Acquisition• Electric Propulsion & Power Processing• Nuclear Thermal Propulsion (NTP) Engine	<ul style="list-style-type: none">• Closed-Loop & High Reliability Life Support Systems• Fire Prevention, Detection & Suppression (reduced Pressure)• EVA Deep Space Suits, including lunar & Mars environment• Advanced EVA Mobility (Suit Port)
Space Power & Energy Storage (TA03)	Long Duration Human Health (TA06)
<ul style="list-style-type: none">• High Strength & Autonomously Deployable In-Space Solar Arrays• Fission Power for Electric Propulsion & Surface Missions• Regenerative Fuel Cells• High Specific Energy & Long Life Batteries	<ul style="list-style-type: none">• Space Flight Medical Care, Behavioral Health & Performance• Microgravity Biomedical Countermeasures• Human Factors & Habitability• Space Radiation Protection/Shielding

Chemical (Cryogenic) In-Space Propulsion

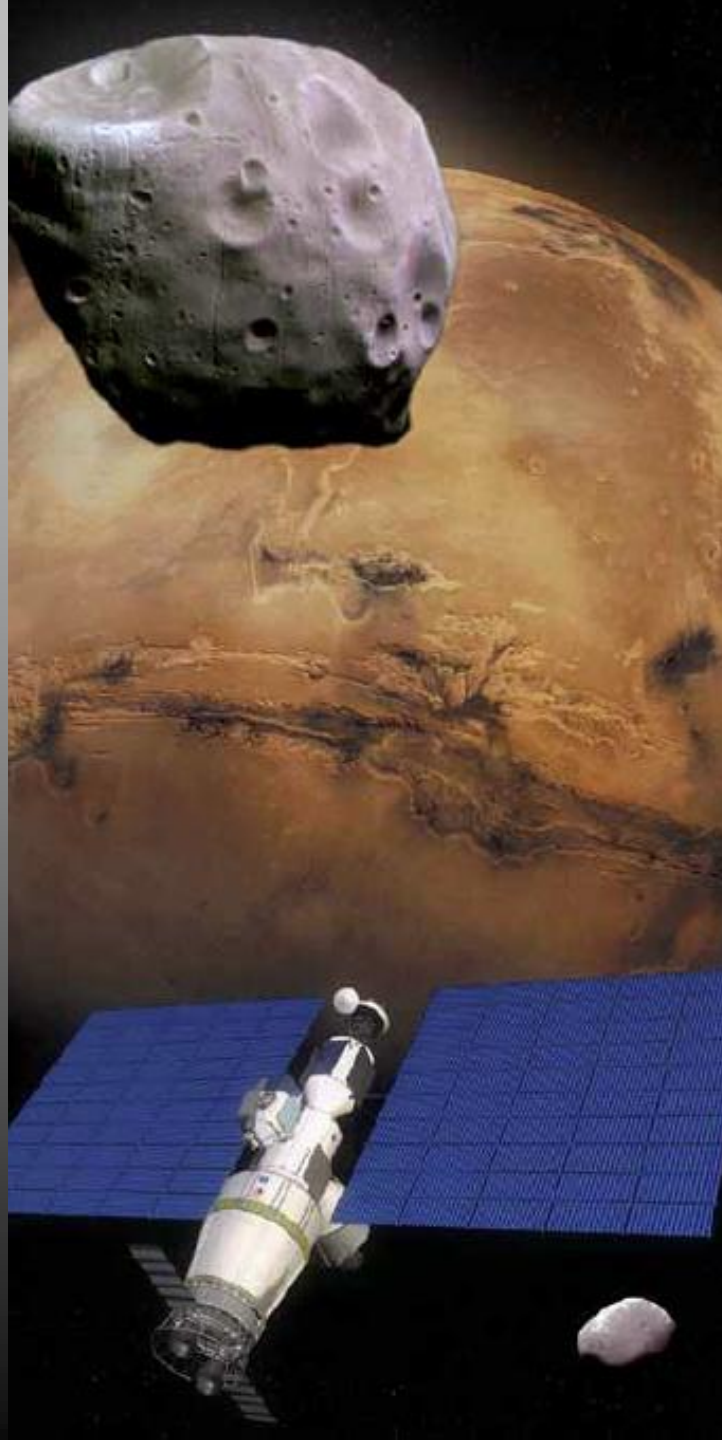


Nuclear Thermal In- Space Propulsion





Solar Electric In-Space Propulsion





Nuclear Electric In-Space Propulsion



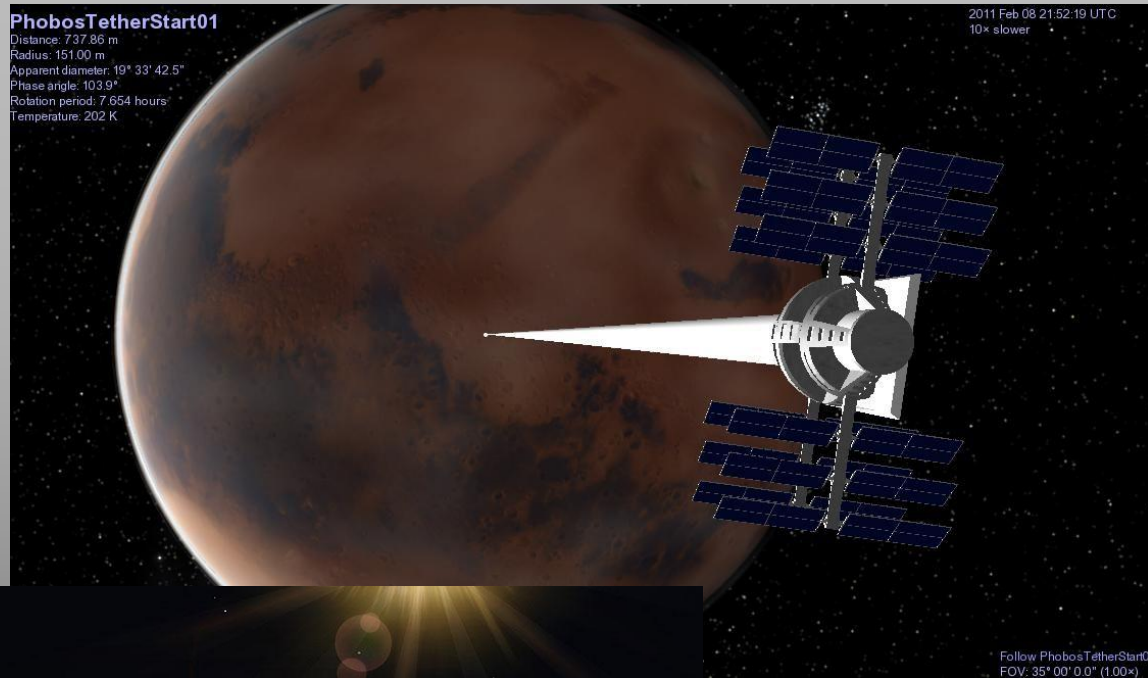


Another Option Breakthrough!

PhobosTetherStart01

Distance: 737.86 m
Radius: 151.00 m
Apparent diameter: 19° 33' 42.5"
Phase angle: 103.9°
Rotation period: 7.654 hours
Temperature: 202 K

2011 Feb 08 21:52:19 UTC
10x slower



Follow PhobosTetherStart01
FOV: 35° 00' 0.0" (1.00x)

